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EDWARD F. CARPENTER, P.E.
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November 14, 1978

Allied Mission Oil Company
c/o Dr. Robert Young
612 Rico Court
Grand Junction, CO 81501

Dear Dr. Young:

Attached is my report on the mine waste discharge of the Vanadium Queen Mine, San Juan County, Utah.

As a result of the extensive testing, we recommend an Ammonium Hydroxide - Ferric Sulphate precipitation process for removing the toxic pollutants. Because of the expense involved, we did not carry the testing far enough to completely define the optimum dosage, nor to test for radium removal. The literature reveals that at least 90% removal of radium can be expected.

The use of a chemical feeder for the Ferric Sulphate is recommended, but a home made feeder using a steel drum and petcock feeder will probably suffice, although the amount of chemical used cannot be as closely controlled. It is also recommended that the Ammonium Hydroxide be purchased in 100 lb. bottles under pressure, which requires only a regulator and injector feeder. A standard platform scale can be used to monitor the rate of feed.

A detention pond of smaller size would be adequate provided some recirculation by air pressure or pumping was provided. Therefore, the pond size was increased in the belief that a few cubic yards of excavation was less expensive than the recirculation required. The longer precipitation time is calculated to be adequate, even when the pond is partially filled with precipitate.

It has been a pleasure to do this work for you, and we appreciate the opportunity to serve you.

Very truly yours,

Edward F. Carpenter

Edward F. Carpenter, P.E.
Utah Professional Engineer No. 4000

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